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شبكة المعلومات الجامعية

بسم اللّه الرحمن الرحيم

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التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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بالرسالة صفحات
لم ترد بالأصل

INFLUENCE OF IRRIGATION LEVELS ON THE GROWTH, MINERAL CONTENT, AND FRUIT QUALITY OF "ANNA" APPLES

BY

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B.Sc. Cairo University, 1991

Thesis

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ABSTRACT

this investigation was conducted to evaluate the response of 8 year - old " Anna " apple trees, to different irrigation treatments and emitters distribution. Water requirements were calculated based on the climatic data, consequently an irrigation program included three irrigation treatments : optimum rote 100 % of the crop water requirement (CWR), medium rate (75% CWR) and low rate (50 % CWR). Emitters were arranged as an emitter (16 l./h.) , 2 emitters (8 l. / h.) and4 emitters (4 l./h.). Moderate irrigation rate ..(75 % CWR) recorded the best results in order to vegetative , root and fruit growth , yield, fruit properties and water efficiency . Regarding the effect of emitter position , the best results were found with (y) treatment under optimum and moderate irrigation rates or (X) position under low irrigation rate. In addition to overcome the bad effect due to shertaye in water availabe for irrigation , it is preferable to use one emitter of high dscharge (16 l/h) against each tree trunk, while under the normal condition , two emitters (8 l/h) followed by 4 emitters (4 l/h) tree is recommended.

A.T. Salem

Use Other Side if Necessary

(Cairo Univ. Press. 1524-1984-5000 ex.)

APPROVAL SHEET

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Introduction

Water is one of the most important components in biological systems, as biological functions depends completely on water. In green plants, water is an essential structural component of protoplasm and membranes, supplier of H^+, nutrient solvent, and participant in photosynthesisi (Salisbury and Ross, 1985). In higher plants, to which the majority of horticultural crops belong, water is essential for mineral transport and food translocation, transpiration to stabilize plant temperature, and respiration. Seed germination and plant growth, composition, and enzymatic and hormonal functions also depend on water (Crafts, 1968; Gates, 1968 and Kirkham, 1990). In the basic step of photosynthesis, for each CO_2 molecule reduced, two H_2O molecules are oxidized. Thus, each glucose molecule produced by the plant requires 12 H_2O molecules. In controlled experiments with horticultural crops, photosynthetic rates were greatly reduced, and consequently, plant growth and development retarded when water supply was restricted (Behboudian, 1977; Gates, 1968; Wright and Stark, 1990). The largest amount of water is used for transpiration (Hanks, 1983) Corn, for example, traspires 225 Kg of water for each 1 Kg of dry matter produced (Hanks, 1983). Without irrigation, horticultural crops in major Egypt production areas could not be produced economically, if at all. Water resources, which were considered almost inexhaustible in past decades, are under severe stress, because water is being pumped from its source at a higher rate than it is being recharged. Reduced well yields and increased pumping costs have made irrigation too expensive.

With increased population growth and increased industrial and commercial activities, less water is or will be available for agricultural use. Water quantity and its distribution among the user groups thus has become a sociopolitical issue that will continue to affect agriculture. In Southwestern Florida, a water managment agency recommended that, by 2000, agricultural operations must increase their irrigation system efficiencies from the current 40% to 85% (Graddy, 1990). At the same time, per capita water consumption must decrease from the current 700 litres/day per person (lpd) to 454 lpd. Dwindling available water resources create problems not only for the general public and governmental regulatory agencies, but also for scientists working on water research and crop production. The agricultural industry expects scientists to conduct research and find methods to produce crops with less water and without reducing yield quantity and quality.

Apple production is important in many countries, across a range of differing climatic conditions. In some of these countries, water is often a valuable natural resource. Minimizing water use not only reduces production costs, especially where fertigation is normally practised but also helps to meet the environmental regulations that many countries are adopting to reduce the leaching of nutrients into ground water. Before reduced irrigation can be adopted as a management strategy, it is important to understand its effect on commercial apple production. Although the effects of deficit irrigation on the vegetative growth of apples have been studied (e.g. Durand, 1990), there is less information on its influence on fruit quality. Previous studies indicate that apple fruit produced during water deficits have lower water content, enhanced fruit color (Drake *et al.*, 1981), increased total soluble solids (Guelfat'Reich *et al.*, 1974).

However, information on the change in mineral composition is conflicting. Irving and Drost (1987) recorded no differences in N, P, K or Mg concentrations with differing irrigation regimes, whereas Guelfat'Reich *et al.*, (1974) reported a general decrease in mineral concentration in fruit from non-irrigated treatments.

Generally, the present investigation was designed to study the influence of water quantity calculated according to the meterological data as well as emitter position on lateral lines on vegetative growth, leaf relative water content, stomata impressions, leaf chemical content, yield and fruit quality, water efficiency and root distribution of "Anna" apple trees budded on Malling Merton 106 rootstock.

Review of literature

I. Effect of different irrigation rates on some growth parameters :

1. Plant growth :

Sadamori and Murakmi (1952) on some apple rootstocks, noticed that, the maximum growth rate occurred at 44% soil moisture content. In 4 years' trials with young peach trees Storchus and Kosykh, (1983) found that tree growth was improved when the soil moisture dropped to 60,70 or 80% of field capacity (FC). Besides, the best results were obtained by irrigation at 80% FC. In a study in irrigation of apple trees at 75-85% (wet), 60-70% (semi-wet), 45-55%(dry) of the water holding capacity, Kuroda *et al.*, (1985) reported that the vegetative growth was increased with increasing soil moisture content.

Studying the response of bitter almond seedlings to different water regimes, Draz (1986) revealed that plant growth expressed as plant height and shoot length was greatest and had a larger amount of increase when grown under low water stress. These increments decreased with increasing the soil moisture tension. The reduction occurred when the soil moisture depletion increased from 60 to 70% of the available soil moisture. Similar results were reported by Lishchuk *et al.*, (1988) on apple and peach, Scholtens (1990) as well as Dongjiankang *et al.*, (1994) and Mills *et al.*, (1996) on apple and Wojtkiewicz and Szewczuk (1990) on peach and cherry.

The same trend was also recorded on some evergreens (El-Hefnawi (1986) on guava seedlings, Mageed *et al.*, (1988) on citrus, Marler and

Davies (1990) on "Hamlin" orange trees and Chandel and Ranbirsingh (1992) on mango).

In an experiment whereas the irrigation was applied at soil matric potential of -10 Kpa, -15 Kpa, or applied daily according to class A pan evaporation Assaf *et al.*, (1988) found that irrigation at soil matric potential at -15 Kpa decreased growth of "Golden Delicious" apple. In addition, when the soil moisture maintained at wet (PF 1.5-2.3) and dry (PF 2.5-2.8) treatments, Kato and Narita (1989) found that, apple trees of dry treatment in May-June ceased shoot growth earlier than trees given the wet treatment, and therefore had shorter shoots in the autumn. Dry treatment at other times did not affect shoot length. Also Chalmers (1990) on pears cv. Bartlett and peach cv. Pavie showed that deficit irrigation at 25% evapotranspiration gave less shoot development than irrigation to 100% of evapotranspiration.

Moreover, Dongjiankang *et al.*, (1994) on "Qinguan" apple trees subjected to non (control), moderate or heavy water stress, appeared that shoot length was 55.5 and 41.6% of control values, respectively. In addition, Safaa (1994) on kaki found that shoot length significantly increased as the soil moisture level was increased. Maas and Vander (1996) in a field trial with "Elstar" apple trees, which recieved water applications in the spring at very low limits or liberal rates followed by an increase in each rate in Aug., they disclosed that growth was markedly reduced at the lower application rates.

On the other hand, Atkinson *et al.*, (1995) on apple found that, trees within the polytunnels received irrigation (4 litres/h, 3 times/day), while for comparative purposes some trees outside did not. In the absence of irrigation, final shoot length was greater.

2. Shoot diameter :

Draz, 1986 on bitter almond seedlings found that, the stem diameter was greatest and had a larger amount of increase when it was grown under low water stress. Moreover, such increments were decreased as soil moisture tension was increased, results also showed that most of the reduction occurred when the soil moisture depletion increased from 60 to 70% of the available soil moisture.

Also, "Valencia" orange trees irrigated with 4680 m^3/fed./year (as flood irrigation), followed by the trees irrigated with 3760, 2820 and 1880 m^3/fed./year (as sprinkler irrigation) showed that count of vegetative growth (flush and diameter of shoots) recorded the highest values on the trees irrigated with 4680 m^3/fed./year (as flood irrigation) Swellem (1986).

3. Leaf formation :

Chapman (1973) watered nursery apple trees (cv. Granny smith and Delicious on Morton 778 rootstock) to field capacity, daily, weekly, biweekly or every 3 weeks, over a period of 30 weeks. The observations showed that leaf number was positively affected by the increase of available water. Grapevine root cuttings, cvs Banaty (Thomson seedless) and Romi Red were grown in containers with available moisture levels of 12.5 to 100%, number of leaves were reduced in soil with 12.5% available moisture (El-Barkouki *et al.*, 1979).

However, Draz (1986) found that, number of leaves formed on bitter almond seedlings, were negatively correlated with water stress. In addition, most reduction occurred when the soil moisture depletion increased from 60 to 75% of the available soil moisture. Three levels of soil moisture (90, 70 and 50% of field capacity) in the first season and 70,